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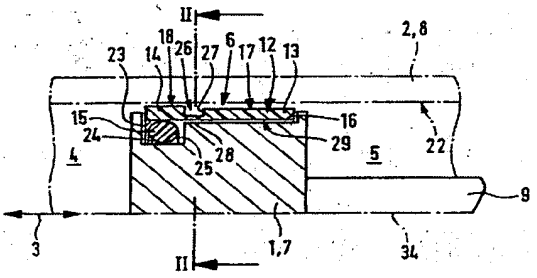
(54) Guiding and sealing ring combination

(57) A guiding and sealing ring combination is suggested for two axially movable converging parts. It comprises a guiding ring (13) and, arranged coaxially adjacent to this, a first sealing ring (14), both of which can be secured to the first (1) of two parts (1,2) such that they moveably abut the second part (2) with a cylindrically contoured guiding or sealing surface. Also present, and carrying out a static sealing function between the first sealing ring (14) and the first part (1) which bears it, is a rubber-elastic, resilient second sealing ring (15) which is arranged concentrically with respect to the first sealing ring (14) and on which abuts the radially opposed peripheral surface (23) of the sealing surface (18). The guiding ring (13) and the first sealing ring (14) are joined into a single-piece, sleeve-like unit over a compression area (26) which is formed axially between them, this compression area (26) making possible a radial positional compensation between the guiding ring (13) and the first sealing ring (14), which is resiliently supported by the second sealing ring (15).



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The following specifications have been taken from the documents filed by the applicant

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Description

The invention relates to a guiding and sealing ring combination for two axially moveable converging parts, with a guiding ring and, arranged coaxially adjacent to this, a first sealing ring, both of which can be secured to the first of two parts such that they moveably abut the second part with a cylindrically contoured guiding or sealing surface and, carrying out a static sealing function between the first sealing ring and the first part which bears it, a rubber-elastic, resilient second sealing ring which is arranged concentrically with respect to the first sealing ring and on which abuts the radially opposed peripheral surface of the sealing surface.

Such arrangements, consisting of a guiding ring and two sealing rings, have been employed up until now primarily in pneumatically operated working cylinders in order to both seal and guide the piston, which forms the first part, in relation to the cylinder tube, which forms the second part. The guiding ring securely encloses the piston and ensures the precise guidance of the piston in its movement. The first sealing ring bears a radial pre-stressing through the second sealing ring which, by comparison, consists of a softer material, and is pressed with its sealing surface into dynamic sealing contact with the opposing surface, formed by the cylinder tube. The second sealing ring, which sits constantly in a groove of the piston, also acts as a purely static seal between the first sealing ring and the piston. The resiliency of the second sealing ring ensures that the first sealing ring is constantly held in optimal contact with the cylinder tube, even when small positional changes occur between the piston and cylinder tube.

Although convincing in terms of function, the known guiding and sealing ring combination is, primarily due to the variety of parts, relatively expensive to manufacture and assemble. It is thus the object of the invention to simplify the manufacture and assembly while maintaining the good guiding and sealing functions.

This object is realized by the fact that the guiding ring and the first sealing ring are joined into a single-piece, sleeve-like unit over a compression area which is formed axially between them, this compression area making possible a radial positional compensation between the guiding ring and the first sealing ring, which is resiliently supported by the second sealing ring.

In this way, the guiding ring and the first sealing ring are joined into a single component. At the same time, in order to functionally uncouple the rings, and furthermore, to make it possible for the first sealing ring and the guiding ring to perform their allocated functions, each independently of the other ring, a compression area is provided axially between the two rings which ensures the appropriate degree of freedom. Since the guiding and sealing ring combination henceforth comprises two parts, including the second sealing ring, the manufacture as well as the assembly is significantly simplified.

Advantageous modifications of the invention are given in the subordinate claims.

The resiliency in the compression area can be ensured, for example, by perforating the respective area, such that a weakening of the material is present.

A further possibility for the preparation of the compression area consists in forming the respective area of the sleeve-like unit, which contains the guiding ring and the first sealing ring, with a reduced wall thickness in comparison to said rings. For this, the sleeve-like unit can have a ring-like, circular, groove-like recess. In a longitudinal section through the sleeve-like unit with

a cutting plane which extends radially and axially, the compression area represents, for practical purposes, a bridge-like connecting link over a space between the two rings.

An optimal uncoupling between the two rings arises when the compression area is formed thinly as in a film or foil.

The compression area can be continuously closed in the peripheral direction of the sleeve-like unit. However, it is also possible to provide the compression area with radial through holes, such that bridge-like, individual connecting links arranged with spacing occur along the periphery of the sleeve-like unit between the two rings joined as a single piece.

Preferably, the guiding ring and the first sealing ring are composed of a uniform plastic material which is harder than the material of the second sealing ring, such that as little backlash occurs as possible in the dynamic contact area with the second part.

The guiding and sealing ring combination can be employed in connection with any two converging parts. The preferred area of application is that of working cylinders. Here, the guiding and sealing ring combination can be secured to the piston and be in slidable contact with the cylinder tube, or it can be secured to a cylinder housing, especially in the area of a cylinder cap, and in so doing encloses it in guiding the penetrating piston and dynamically seals it.

In the following, the invention is illustrated in further detail by means of the accompanying drawings. The drawings show:

Fig. 1: a preferred design of the guiding and sealing ring combination mounted on the piston of a working cylinder to guide and seal it in relation to a cylinder tube, which is only implied with a dot and dash line; the entire assembly is shown in longitudinal section along an axial and radial cutting plane.

Fig. 2: the arrangement from **Fig.** 1 in cross-section with a radial cutting plane per line II-II in **Fig.** 1, and

Figs. 3 and 4: a radial top view of two further design options of the sleeve-like unit in which the guiding ring and first sealing ring are conjoined, each being respectively usable in a manner corresponding to **Figs.** 1 and 2, and each appearing in partial illustration.

Emanating from **Figs.** 1 and 2 is the piston 1 of a working cylinder, which is intended to execute a back-and-forth work motion per the double arrow 3 in a cylinder tube 2 arranged per the dot and dash line. The piston 1 can be joined to a piston rod 9. The axial movement of the piston 1 is brought about by the selective addition and/or subtraction of fluid pressurizing medium in the work spaces 4,5 mutually separated by the piston in the cylinder tube. In the embodiment example, this is, particularly, a pneumatic pressurizing medium.

A guiding and sealing ring combination 6 arranged in the radial intermediate area between the piston and the cylinder tube 2 sees to it that the first part 7, formed by the piston 1, and the second part 8, formed by the cylinder tube 2, are exactly guided in their motion with respect to each other, and that, moreover, no pressurizing medium overflows between the two work spaces 4,5 via the radial intermediate area.

The guiding and sealing ring combination 6 is joined with the first part 7, formed by the piston 1, in such a way that it can move axially with it. The combination is in dynamic contact with the

second part 8 formed by the cylinder tube 2 in the embodiment example when set in the operating position, such that it can glide along the same.

The guiding and sealing ring combination 6 according to the example consists of two components which work together functionally. The first component is a sleeve-like unit 12 in which a guiding ring 13 and a first sealing ring 14 are conjoined in a single-piece design. The second component is a second sealing ring 15, which is formed separately in relation to the sleeve-like unit 12. All three rings 13, 14, 15 are arranged coaxially with respect to each other.

The sleeve-like unit 12 is secured in the area of the radially outwardly pointing outer periphery. It is situated purposefully in a groove-like peripheral recess 16 of the piston 1, such that it is secured axially.

Even if considered in and of themselves, both portions of the sleeve-like unit 12 which form the guiding ring 13 and the first sealing ring 14 already purposefully have a sleeve-like shape, and the overall axial length of the guiding ring 13 is purposefully larger than that of the first sealing ring 14.

The guiding ring 13 and the first sealing ring 14 are arranged axially adjacent to each other. In the operation-ready state, the guiding ring 13, with a guiding surface 17 pointing radially away from the piston, and the first sealing ring 14, with a correspondingly arranged sealing surface 18, slidably abut the inner surface 22 of the cylinder tube.

The second sealing ring 15 is arranged concentrically and radially within the first sealing ring 14. With its radially outwardly pointing peripheral portion, it abuts the peripheral surface 23 of the first sealing ring 14 radially opposed to the sealing surface 18. With its at present radially inwardly pointing surface portion facing away from the first sealing ring 14, the second sealing ring 15 abuts the opposing surface 24 of the first part 7, which is presently the base of a ring-shaped and groove-like peripheral recess 25 of the first part 7, housing the second sealing ring 15, which houses the second sealing ring 15 [sic].

The dynamic sealing contact between the sealing surface 18 and the inner surface 22, as well as the static sealing contacts between the second sealing ring 15 and the inner peripheral surface 23 on the one hand and the opposing surface 24 on the other hand, effectuates the seal between the piston 1 and the cylinder tube 2.

In order to keep wear to a minimum, the first sealing ring 14 is composed of relatively hard, wear-resistant plastic, for example, a polytetrafluorethylene plastic. The second sealing ring 15, on the other hand, which has an exclusively static sealing function, is composed of plastic with rubber-elastic properties, elastomer material being particularly used here. The individual parts are purposefully coordinated such that the second sealing ring 15 is slightly pressed together radially by the first sealing ring 14, at least in the operating position when the piston 1 is inserted into the cylinder tube 2. Due to the elasticity of the second sealing ring 15, the first sealing ring 14 is in constant radial pre-stressing in the direction of the inner surface 22. This ensures that a sufficiently acute sealing contact is maintained between the sealing rings 14, 15 and the two parts 7,8 intended to seal each other off.

The guiding ring 13 should be arranged with as little backlash as possible between the two parts 7,8, so that no relevant cross-traverse backlash is present between these. In order to free up the first sealing ring 14, which is formed in a single piece with the guiding ring 13, for the radial

motion necessary for its function, the adjoining area between these two rings is structured as a compression area 26, which makes possible a potentially necessary positional compensation within the sleeve-like unit 12 between the portions forming the guiding ring 13 and the first sealing ring 14.

In the embodiment example of **Figs.** 1 and 2, the compression area 26 is formed by a hollow cylindrical section 28 of the sleeve-like unit 12 which, in comparison to the radial wall thickness of the guiding ring 13 and the first sealing ring 14, has a significantly smaller wall thickness. According to the example, a circular, groove-like recess 27 is provided in the sleeve-like unit 12 in the appropriate area and radially from the outside, such that only said thin section 28 is present. The recess 27 can be produced mechanically, but can also be produced in a non-cutting manner through a direct molding when the sleeve-like unit 12 is produced as an injection-molded part.

It is advantageous if the sleeve-like unit 12 has, radially on the inside, a cylindrical peripheral surface 29 which is continuous over the entire axial extension, as shown in **Fig.** 1. In this case, the section 28 of the unit 12 which defines the compression area 26 is located in the immediate vicinity of the first part 7, which bears the sleeve-like unit 12.

An optimal, functional uncoupled arrangement of guiding ring 13 and first sealing ring 14, which ensures the independent function of each element, is also guaranteed in the embodiment example particularly by the fact that the section 28 connecting the guiding ring 13 and the first sealing ring 14 and forming the compression area 26 has the thickness of a film or foil. The first sealing ring 14 can therefore move radially with respect to the guiding ring 13 and is, at the same time, an integral part of the uniformly manageable sleeve-like unit 12.

The compression area 26 is closed along its entire periphery in the embodiment example according to **Figs.** 1 and 2, and the entire sleeve-like unit 12 purposefully forms an impenetrable part. The design option as shown in **Fig.** 3, however, makes it clear that the thin-walled compression area 26 or the allocated section 28 can also have radial through holes 33 which are arranged with spacing one after the other with respect to the longitudinal axis 34 in the peripheral direction of the compression area 26, such that individual, bridge-like connecting links 35 result between them. In such a design, an especially flexible connection of the individual ring sections of the sleeve-like unit 12 results.

Collectively, a uniform material will purposefully be used for the sleeve-like unit 12, and a plastic material is preferred. In this case, the material used for guidance is identical to that used for the dynamic sealing. The manufacture of the sleeve-like unit 12 is especially simple in this case.

As a second sealing ring 15, one with a ball-like cross-section contour is purposefully used. In the embodiment example, an o-ring is provided.

It can be suitable to provide the first sealing ring 14 with a larger wall thickness than that of the guiding ring 13. In this case, the first sealing ring 14 is shifted or compressed in the pushed-together state of the two parts 7,8 radially in the direction of the second sealing ring 15 which acts upon it, such that the sealing surface 18 is aligned in the axial direction with the guiding surface 17.

In the design option as shown in **Fig.** 4, the sleeve-like unit 12 has, at least in essence, a constant wall thickness over its entire axial length. The compression area 26 is characterized in that an area of the same taking up a section of length of the sleeve-like unit 12 is provided with a plurality of through holes 37, such that it can be considered to be a perforated area. By means of the perforation, the stiffness of the connection between the two sections of the sleeve-like unit 12 forming the first sealing ring 14 and the guiding ring 13 is reduced, which bring about the required degrees of freedom of movement.

It is clear that the guiding and sealing ring combination 6 can be used in any combination of two converging parts. It is especially suitable for the guiding of the piston rod of a working cylinder in the area in which the piston rod penetrates the housing of the working cylinder, by which means the through hole area is also sealed off. In this case, however, the guiding and sealing ring combination 6 is arranged with a fixed housing, such that the guiding surface 17 and the sealing surface 18 are in moving contact with the piston rod. Here, the second sealing ring 15 would be arranged such that it does not act upon the first sealing ring 14 radially from inside, as in the embodiment example per Figs. 1 and 2, but rather radially from outside.

The assembly of the sleeve-like unit 12 on the first part 7, which bears it, is purposefully made easier by providing possibilities for temporarily opening, in an axial manner, the peripheral recess 16 which houses the sleeve-like unit 12. This is purposefully done in the case of a first part 7 formed by a piston 1 by forming the piston in a plurality of parts with a plane of osculation which runs at a right angle to the longitudinal axis 34. This plane of osculation is purposefully set in the piston area lying radially adjacent to the compression area 26, such that the compression area 26 can also compensate for potential assembly tolerances between the two piston parts.

The longitudinal section of the sleeve-like unit 12, especially, which forms the guiding ring 13, can be made with a slotted design, this slot running axially, or at least exhibits an axial extension component. In this way, an automatic adjustment to the circumference of the two parts 7,8 can occur.

In summary, it can be put on record that a both a guiding and bearing function as well as a dynamic sealing function are integrated into the sleeve-like unit 12. Located axially between the two ring sections, each allocated to their corresponding function, is a compression area 26 which purposefully has neither a guiding function nor a sealing function, and which joins the two ring sections in a single piece in such a way that these can perform their intended tasks largely independent of one another. The result is a reduction in the variety of parts and simple manufacture, without incurring functional disadvantages. The assembly is also simplified, since the spatial arrangement between the guiding ring 13 and the first sealing ring 14 is firmly predetermined, and the parts for the two functions can thus always be assembled with proper allocation.

Patent claims

1. Guiding and sealing ring combination for two axially moveable converging parts, with a guiding ring and, arranged coaxially adjacent to this, a first sealing ring, both of which can be secured to the first of two parts such that they moveably abut the second part with a cylindrically contoured guiding or sealing surface and, carrying out a static sealing function between the first sealing ring and the first part which bears it, a rubber-elastic, resilient second sealing ring which is arranged concentrically with respect to the first sealing ring and on which abuts the radially opposed peripheral surface of the sealing surface, **characterized in that** the guiding ring (13) and the first sealing ring (14) are joined into a single-piece, sleeve-like unit over a compression area (26) which is formed axially between them, this compression area (26) making possible a radial positional compensation between the guiding ring (13) and the first sealing ring (14), which is resiliently supported by the second sealing ring (15).
2. Guiding and sealing ring combination according to claim 1, characterized in that the compression area (26) is formed by a perforated area (36) of the sleeve-like unit (12) which is provided with through holes distributed along the periphery of the sleeve-like unit (12).
3. Guiding and sealing ring combination according to claim 1 or 2, characterized in that the compression area (26) is formed by a ring-shaped or hollow, cylindrical section (28) of the sleeve-like unit (12) which has a smaller radial wall thickness in comparison to the guiding ring (13) and the first sealing ring (14).
4. Guiding and sealing ring combination according to claim 3, characterized in that the sleeve-like unit (12) has a circular, groove-like recess (27) on the radial peripheral surface opposed to the second sealing ring (15) for the formation of the compression area (26).
5. Guiding and sealing ring combination according to one of claims 1 to 4, characterized in that the compression area (26) is film-like or foil-like.
6. Guiding and sealing ring combination according to one of claims 3 to 5, characterized in that the compression area (26) has radial through holes (33), such that bridge-like, individual connecting links (35) arranged with spacing occur along its periphery.
7. Guiding and sealing ring combination according to one of claims 1 to 6, characterized in that the wall thickness of the first sealing ring (14) is larger than that of the guiding ring.
8. Guiding and sealing ring combination according to one of claims 1 to 7, characterized in that the peripheral surface (29) of the sleeve-like unit (12) which is radially oriented toward the second sealing ring (15) is formed cylindrically and in a non-gradated manner.
9. Guiding and sealing ring combination according to one of claims 1 to 8, characterized in that the sleeve-like unit (12) is composed of a uniform plastic material and is harder than the second sealing ring (15).

10. Guiding and sealing ring combination according to one of claims 1 to 9, characterized in that the second sealing ring (15) has a ball-like cross-section contour and is particularly an o-ring.

11. Guiding and sealing ring combination according to one of claims 1 to 10, characterized in that the first part (7) of the piston (1) and the second part (8) of the cylinder tube (2) is formed in the manner of a fluid, and particularly a pneumatically operable, working cylinder.

12. Guiding and sealing ring combination according to one of claims 1 to 11, characterized in that the first part of the housing, and particularly of a cylinder cap and the second part of a piston rod, is formed in the manner of a fluid, and particularly a pneumatically operable, working cylinder.

With 1 page(s) of drawings

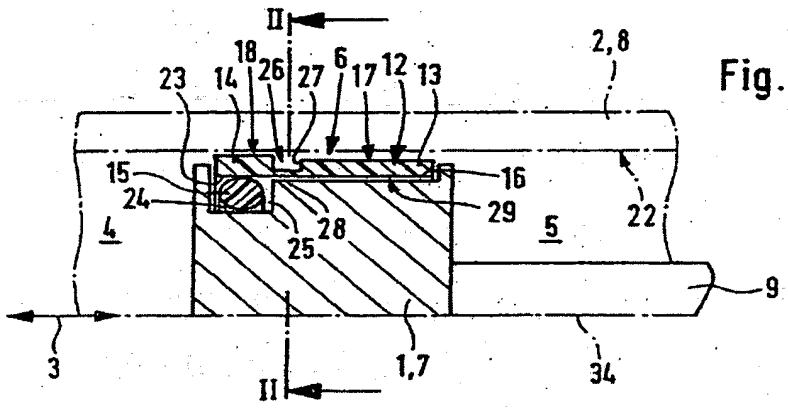

Fig. 1

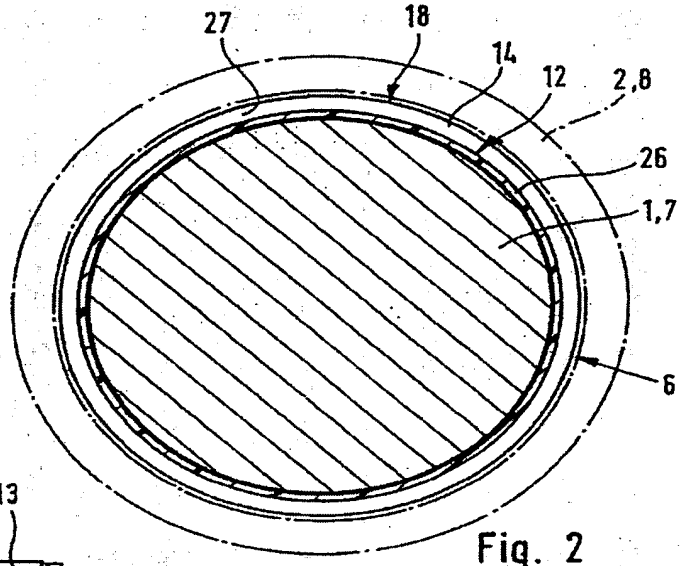

Fig. 2

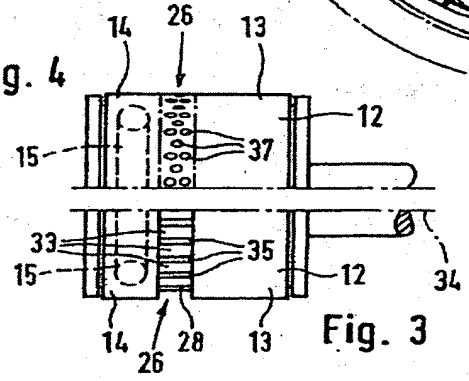

Fig. 4

Fig. 3